

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF SECRETARY

In the Matter of)

Allocation of Spectrum Below)
5 GHz Transferred from)
Federal Government Use)

ET Docket No. 94-32

~~DOCKET NO. 94-32~~

COMMENTS OF APPLE COMPUTER, INC.

Apple Computer, Inc. ("Apple") hereby submits its comments in response to the Second Notice of Proposed Rulemaking ("Second NPRM") in the above-captioned proceeding. Specifically, Apple addresses the questions raised by the Commission with respect to the 2390-2400 MHz band.

Apple strongly supports the Commission's decision to allocate the 2390-2400 MHz band for wireless computing devices, including nomadic Data-PCS devices, and to make this allocation secondary only to the Amateur service. Data-PCS devices represent an important new technology with numerous public benefits, as the FCC, members of Congress, and many parties filing comments in this proceeding and the FCC's PCS proceeding have recognized. The Commission's allocation satisfies its announced intent to provide additional, suitable spectrum for Data-PCS, which will complement the existing Data-PCS allocation.¹ In addition, the unique attributes of the 2390-2400 MHz band will make possible the prompt deployment of Data-PCS devices on a nationwide basis. Finally, this allocation will protect the requirements of Amateur users and planetary radar operations at the Arecibo Observatory.

¹ The 2390-2400 MHz band and the 1910-1920 MHz band each offer unique attributes. The 2390-2400 MHz band is immediately available, and will permit prompt deployment of nomadic devices. In addition, certain manufacturers may be able to benefit from the band's proximity to the 2.4 GHz ISM band, subject to the constraints discussed in Section I below. The 1910-1920 MHz band, on the other hand, lies within the licensed-PCS band, which will permit the development of multi-use devices. Thus, for example, it may be possible for network providers and manufacturers to introduce portable devices that access public PCS networks outdoors or throughout whole regions, but connect to user-provided networks (which may support higher data rates and have lower or no "connect" charges) where available. In addition, the band's proximity to the unlicensed isochronous PCS band will provide multi-use opportunities.

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Apple also supports the Commission's efforts promptly to resolve the few remaining questions raised in the Second NPRM. The computer industry has sought the availability of suitable unlicensed Data-PCS spectrum for more than four years, and now stands ready to begin deploying unlicensed devices that will fulfill the promise that both the Commission and its proponents foresaw.

In particular, the Commission requested comment on the following three questions:

- Should the existing service rules for the 2390-2400 MHz band be modified to accommodate operations that combine use of this band with use of the adjacent 2400-2483.5 MHz band?²
- Should additional measures be included in the rules to protect space research operations?
- Should additional restrictions be imposed upon Data-PCS or Amateur service operations to avoid disruptions in the shared band?

I. THE COMMISSION SHOULD NOT ALTER THE TECHNICAL RULES GOVERNING THE 2390-2400 MHZ BAND IN ORDER TO PERMIT INTER-OPERABILITY WITH THE 2400-2483.5 MHZ BAND.

As Apple has discussed in previous filings in this proceeding and in the PCS proceeding, Data-PCS is not merely a "tweak" of an existing technology. Rather, it is a new radio service that will enable users of personal computers to communicate at high data rates over distances of up to 50 meters, without wires or other fixed connections.

Data-PCS will support high-speed, ad hoc data communications via unlicensed devices in large part due to the underlying spectrum etiquette governing operation in the band. The spectrum sharing rules were designed to permit coexistence among dissimilar technical approaches, vendors, and applications, within a minimal set of rules. The rules call for channel sensing, algorithms for deferral and contention of transmissions, rules for searching for available channels, RF bandwidths between 500 kHz and 10 MHz, power

² For the sake of convenience, Apple will refer to the 2400-2483.5 MHz band as the "2.4 GHz ISM band."

proportional to bandwidth, and limits on channel acquisition and upon retention of the channel before recontention.

In contrast, the rules for the adjacent 2.4 GHz ISM band include none of these requirements. They were never intended to be, nor are they in practice, rules that optimize coexistence or govern access and usage. In fact, they limit only transmitter power and out-of-band emissions and dictate spread spectrum modulation schemes,³ or severely restrict power.⁴ Numerous communications devices and virtually all ISM devices currently in the ISM band are not capable of observing an overlying etiquette.⁵

When the Commission allocated an additional 10 MHz for Data-PCS, it appropriately applied the etiquette-based rules developed for the 1910-1920 MHz band to the 2390-2400 MHz band. If the Commission were to permit devices operating only under the rules governing the 2.4 GHz ISM band to cross over into the 2390-2400 MHz band, it would enable parties to inject devices that are not etiquette-conformant into the Data-PCS band. This would be tantamount to resetting the process completely and would fatally undercut the value of the 2390-2400 MHz band. Among many other things, the record in the PCS proceeding demonstrates that real-time voice systems and packet data systems cannot coexist in a restricted spectral domain; yet many Part 15 ISM band devices support real-time voice or other isochronous communications.

If the Commission were to modify the rules governing the 2390-2400 MHz band, it would not take long for isochronous devices to monopolize the band. In light of crowding within the 2.4 GHz ISM band, the creation of a single homogenous Part 15 band encompassing the entire 2390-2483.5 MHz band could lead to a frantic rush to shift communications products of all natures to the relatively-quiet 2390-2400 band. Many of these devices would likely be isochronous, and their introduction into the 2390-2400 MHz band would render

³ See 47 CFR §15.247.

⁴ See 47 CFR §15.249.

⁵ The IEEE's 802.11 standards group has endeavored to develop a standard or standards for interoperation of wireless LANs in the 2400-2483.5 band. Much work remains before the standard is approved, and in any case the standard will be a voluntary one. Moreover, it does not deal in any way with the myriad non-LAN devices that now occupy the band, or others yet to come.

it of little value, if any at all, for deployment of etiquette-complying Data-PCS devices.

This does not, however, mean that interoperability will be prohibited. The rules that govern asynchronous devices operating in the 2390-2400 MHz band (in particular, Section 15.321) offer wide latitude, within the etiquette, to employ a variety of technologies. They do not inherently preclude spread spectrum modulation schemes, nor should they. It is possible that, through innovative engineering, devices could be developed that comply with all elements of both sets of rules, or devices could be devised that change operating characteristics depending upon which of the bands they are occupying at the moment of transmission. Compliance testing procedures should provide for such devices.

II. PLANETARY RADAR INSTALLATIONS AT ARECIBO MUST BE GIVEN SUFFICIENT PROTECTION.

The Commission appropriately requested information regarding the possible impact of Data-PCS devices upon the space research operations in the 2370-2390 MHz band that are conducted at the National Astronomy and Ionospheric Center ("NAIC") at Arecibo, Puerto Rico. NAIC, Cornell University and the National Research Council have previously expressed concern about out-of-band emissions from Part 15 and Amateur transmitters (including harmonics and other spurs), as well as signals properly contained in the newly allocated spectrum.

With respect to in-band emissions, it appears improbable that unlicensed low-power Data-PCS devices will cause receiver-overload interference at Arecibo unless they are operated in the immediate vicinity of the planetary research station. The one exception to this general rule is interference caused by aeronautical use. Apple therefore supports the Commission's proposal to prohibit aeronautical operation of any transmitting Data-PCS device in the vicinity of Arecibo.⁶

NAIC's other concerns — in particular, whether out-of-band emissions meeting the attenuation requirements of Section 15.321(d) could, under some circumstances, interfere with astronomical data-gathering — merit additional

⁶ Second NPRM at ¶ 56.

study. Unlike in-band intended radiation, it may be both necessary and technically feasible to decrease out-of-band emissions below the levels already imposed by Section 15.321(d). This would, however, increase the cost of Data-PCS devices and, therefore, could reduce their availability to certain segments of the population (including, for example, educational users) if applied across the board to all Data-PCS products. As a result, it will best serve the public interest for the parties to ascertain the maximum levels of spurious emissions from Data-PCS devices that can be tolerated by the radio astronomy community, and to develop an approach that assures that the limit is not exceeded while imposing the smallest possible burden on Data-PCS devices.

Apple and NAIC representatives have had preliminary discussions aimed at resolving these open questions. Apple believes that NAIC will conclude that Data-PCS and Amateur users (as well as Part 15 devices operating in the 2.4 GHz ISM band) are hospitable neighbors (better than all others proposed by the Commission). Apple is confident that the parties will be able to develop a mutually acceptable sharing approach, and therefore urges the Commission not to impose any new technical requirements at this time.

III. COEXISTENCE OF PART 15 AND AMATEUR USERS OPERATING IN THE 2390-2400 MHZ AND ISM BAND SHOULD BE FACILITATED THROUGH ONGOING DISCUSSIONS AMONG THE PARTIES.

As the Commission recognized,⁷ and as some members and representatives of the amateur community have echoed,⁸ low power unlicensed Data-PCS operations are generally compatible with amateur operations. The low power, low spectral power density, restricted antenna implementation, predominantly indoor operation, and channel-sensing algorithms required of Data-PCS all suggest that the geographic area in which Data-PCS devices could potentially cause interference will be relatively small, in most cases no more than a few hundred feet.

There may, of course, be cases where an individual amateur's operations could be affected by the operation of Data-PCS devices. The Commission has

⁷ Second NPRM at ¶ 57.

⁸ E.g., American Radio Relay League ("ARRL") Ex Parte presentation dated January 26, 1995 (cited in First Report and Order and Second NPRM at n.51).

mentioned frequency coordination as one possible tool to address such cases.⁹ Apple, however, believes that mandatory coordination requirements will constrain the parties unnecessarily, and that both Amateur operators and Data-PCS users would be better off developing spectrum sharing strategies and resolving cases of interference outside a formal set of regulatory requirements.¹⁰

Apple strongly supports Amateur operation in the 2390-2400 MHz band. The very nature of amateur experimentation, and its value in extending the state-of-the-art, makes shared use of this "frontier" frequency band of special interest: it is one of the places where pioneering is needed and possible. Indeed, the ARRL earlier approved a volunteer "band plan" for 2390-2400 MHz that encourages fast scan TV at 2390-2396 MHz, high-rate data (not completely unlike unlicensed Data-PCS, but allowing substantially greater technical flexibility, including transmitter power and antenna gain) at 2396-2399 MHz, packet data transmissions at 2399-2399.5 MHz, and control and auxiliary links at 2399.5-2400 MHz. The informal designation for such operations itself symbolizes some of the advances that can be anticipated.¹¹

The amateur service has also developed numerous techniques for dealing with congestion, channel access, and interference. Anyone who has been "net control" or has been "DX" knows how some of the protocols now used in computer data networks were first developed and applied.

In light of the Commission's allocation (which makes clear that Data-PCS devices will operate on a secondary basis), the Amateur service's success in voluntarily developing frequency-management techniques, and the ability to engage in a productive dialog about band plans, possible coordination, and other measures to optimize use of the 2390-2400 MHz band that Apple, ARRL, and other organizations and individuals have thus far demonstrated, Apple respectfully suggests that there is no need at this time for Federal regulation to

⁹ Second NPRM at ¶ 57.

¹⁰ Data-PCS operations will, of course, remain subject to the "no interference" requirements of Part 15.

¹¹ Apple notes that Amateur usage and band plan details are even more highly developed in the 2300-2310 MHz band, which has now been designated by the NTIA for transfer to the FCC in August, 1995 (ahead of the expected date of January, 1996). "Spectrum Reallocation Final Report," (NTIA Special Publication 95-32) (March 1995).

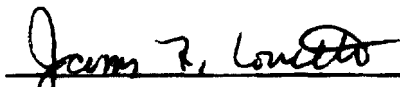
dictate the precise means whereby Data-PCS and the Amateur service will share the 2390-2400 MHz band.

CONCLUSION

For the reasons stated above, Apple respectfully requests that the Commission take the actions discussed herein.

Respectfully submitted,

APPLE COMPUTER, INC.


James F. Lovette
One Infinite Loop, MS: 301-4J
Cupertino, California 95014
(408) 974-1418
jlovette@apple.com

Mary Dent
GOLDBERG, GODLES, WIENER & WRIGHT
1229 Nineteenth Street, N.W.
Washington, D.C. 20036
(202) 429-4900

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